SECTION 3. EARNINGS

Most of the studies we reviewed show that women faculty earn less than their male counterparts do, even after controlling for other factors that affect earnings. The modeling issues discussed here, which focus on the kinds of control variables used in academic salary studies, are important for interpreting our findings from the literature, which we present below.

MODELING ISSUES

Most of the salary studies we reviewed used multivariate regression analysis to control for factors other than gender that might affect the earnings of academic scientists and engineers. Typically, controls were for measures of human capital, measures of productivity, personal characteristics, and academic field.

HUMAN CAPITAL CONTROLS

Measures of human capital that have been used in studies of academic salaries include experience, education, academic rank, and characteristics of employing institutions.

Experience

Almost all of the salary studies we reviewed include some measure of experience as a control variable. Most often, experience is measured as years since earning the doctorate.[11] Bellas (1993) and Lindley et al. (1992) also included measures of experience before earning the doctorate. Several authors, including Ransom and Megdal (1993), Lindley et al. (1992), and Megdal and Ransom (1985), included years of service at the employing institution.[12]

Measuring experience as years elapsed since earning the doctorate (or years employed at the current institution) is an inaccurate indicator of human capital accumulation in that it does not account for workforce interruptions. This issue is important in the context of measuring male-female salary differences. Because of family and child-rearing responsibilities, we might expect women, as a group, to have more frequent and longer workforce interruptions than men do. Bellas (1993) included controls for duration of both unemployment and part-time work in her salary study. Farber (1977) included control variables reflecting changes in jobs and changes in work activity.

Education

Several salary studies we reviewed contain variables reflecting human capital investments in education. Some authors used data that include faculty without doctoral degrees. These studies generally contain variables reflecting the highest degree earned (e.g., doctorate or master's degree) by faculty in the sample. A few studies—Formby et al. (1993), Johnson and Stafford (1974), and Katz (1973)—included indicators of the quality of the graduate school from which faculty earned their degrees.

Academic Rank

Academic rank was used as a control in many of the studies we reviewed. Arguably, individuals who have accumulated the most human capital are more likely to be promoted to higher academic ranks. If this is the case, academic rank can be viewed as a proxy for human capital accumulation that is otherwise unmeasured.[13]

Again, we caution that including academic rank as a control in studies of male-female salary differences is controversial. If women faculty suffer discrimination in earnings, the same might be true for promotions, and thus academic rank would systematically understate the amount of human capital accumulated by women.[14]

Characteristics of Employing Institution

Several studies control for the characteristics of the institutions at which faculty are employed. For example, Broder (1993) controlled for the quality of the employing department in her study of salaries earned by academic economists; Ashraf (1996) included the Carnegie classification of the employing institution as a control; and Bellas (1993) and Formby et al. (1993) included a variable that distinguishes public and private institutions.

Including the characteristics of employing institutions as controls in salary studies raises complicated issues.

[11]Many studies specify experience variables in a nonlinear fashion (e.g., as a quadratic) to capture potential diminishing returns to experience.

[12]Human capital theory distinguishes between general and firm-specific human capital. The notion is that each firm (academic institution) has, to some degree, unique human capital requirements. If firm-specific experience is important, we would expect firm-specific experience to have a larger effect on salary than general experience does.

[13]We could also argue that academic rank is a proxy for unmeasured productivity. The most productive faculty are more likely to be promoted to senior ranks.

[14]The same downward bias exists if we interpret academic rank as a proxy for productivity.

One might argue that the characteristics of the employer serve as proxies for human capital (i.e., individuals who have accumulated the most capital are more likely to land jobs at the most prestigious institutions), but if women are discriminated against in the academic labor market, then employer characteristics might be a biased measure of human capital.

Alternatively, one might argue that institutional characteristics serve as proxies for nonpecuniary job amenities (e.g., quality of students and emphasis on teaching rather than on research). If they do, then measures of institutional characteristics might be appropriate controls for individuals' willingness to trade earnings for nonpecuniary job amenities.[15]

The effect of employer characteristics on earnings is unclear, particularly for junior faculty. The most highly qualified individuals might be expected to find jobs at the most prestigious institutions and be compensated accordingly. But junior faculty taking jobs at the most prestigious universities might expect to accumulate more human capital than they would at other institutions. This suggests they might be willing to trade current income for future returns to investments in human capital.[16]

Measures of Productivity

The most commonly used controls for productivity are those measuring scholarship, teaching, and service to the academic community.

Scholarly Productivity

Simple counts of articles and/or books published were the most frequently used measures of scholarly production in the salary studies we reviewed. Two studies, Raymond et al. (1988) and Farber (1977), included research grants (dollar amounts) as measures of research productivity. In her salary study Bellas (1993) included a variable that measured time spent on research. Several studies, such as Ashraf (1996), Barbezat (1987), and Farber (1977), contained indicators of whether research was the primary work activity.

The literature generally acknowledges the shortcomings of available measures of scholarly production. Simple counts of articles and books published account for neither quality nor the importance of scholarship. Variables reflecting time spent on research are really measures of effort rather than production, and indicators of primary work activity likewise provide no information about faculty productivity.

Teaching Productivity

Controls for teaching productivity are less common in the literature than are controls for scholarship. Those studies that do control for teaching most often use measures of teaching load (hours spent in the classroom or number of courses).[17] In their salary study, Raymond et al. (1988) included grants (measured in dollars) awarded for instructional development. Both Barbezat (1989b) and Farber (1977) included indicators for teaching as a primary work activity.

The shortcomings of available measures of teaching productivity are apparent. Mostly, these measure effort or the focus of work activity, but they do not account for quality or results.

Personal Characteristics

Most of the salary studies we reviewed include some controls for personal characteristics. The most common of these are age, race/ethnicity, marital status, and family size (typically, the number of dependent children). Certainly, the last two characteristics, marital status and family size, are important controls for studies of male-female differences in earnings. As noted above, one hypothesis advanced in the literature is that family and parental responsibilities adversely affect women by making the accumulation of human capital more difficult and by leaving women with less time and energy to devote to their careers.

Findings

We summarize our findings from the literature as two sets of results: those from studies that used nationwide samples, and those from studies that used data from single academic institutions.

Nationwide Samples

Almost all of the studies that used nationwide samples show that women faculty earn less than male faculty do, even after controlling for other factors that might affect salaries. However, the estimated gender gap in earnings after the late 1970s appears to be smaller than the gap that existed in the 1960s and early 1970s.

[15]See our discussion of the Barbezat (1992) study in "Selection Issues," above.

[16]Johnson and Stafford (1974) make this argument.

[17]See, for example, Ashraf (1996), Winkler et al. (1996), Bellas (1993), and Barbezat (1989b).

Also, the estimated size of the gender gap appears to be somewhat sensitive to the kinds of controls used in different studies.

Earnings Differentials Over Time

Table 3-1 summarizes the results of salary studies using nationwide samples. We include in Table 3-1 only those studies that control at least for experience and academic field. This prevents inappropriate comparisons of unequals with respect to professional experience and comparisons across fields where different market conditions exist.

The first column in Table 3-1 identifies for each study the years in which salaries were observed. The second column shows the percentage female differential in earn-

Table 3-1. **Estimates of gender differences in earnings in nationwide samples**

Year[1]	Female differential (Percent)	Rank included	Publications included	Marital status or children included	Source
1965	–12.1	No	Yes	No	Ferber and Kordick (1978)
1966	–16.1	No	No	No	Tolles and Melichar (1968)
1968–1969	–20.7	No	No	No	Barbezat (1987)
1968–1969	–15.9	No	No	No	Ransom and Megdal (1993)
1968–1969	–16.5	No	Yes	No	Barbezat (1987)
1968–1969	–12.9	No	Yes	No	Ransom and Megdal (1993)
1969	–12.0	Yes	Yes	Yes	Ashraf (1996)
1970	–13.6	No	No	No	Johnson and Stafford (1974)
1972	–9.0	Yes	Yes	Yes	Ashraf (1996)
1972	–12.0	No	No	Yes	Haberfeld and Shenhav (1990)
1972–1973	–13.9	No	No	No	Ransom and Megdal (1993)
1972–1973	–11.3	No	Yes	No	Ransom and Megdal (1993)
1974	–12.0	No	Yes	No	Ferber and Kordick (1978)[4]
1974	–10.5	No	Yes	No	Ferber and Kordick (1978)[5]
1975	–10.4	No	Yes	No	Barbezat (1987)
1975	–12.7	No	No	No	Barbezat (1987)
1977	–6.4	Yes	Yes	No	Barbezat (1989a)
1977	–8.0	No	No	No	Barbezat (1987)
1977	–4.6	No	Yes	No	Barbezat (1987)
1977	–9.9	No	No	No	Ransom and Megdal (1993)
1977	–6.8	No	Yes	No	Ransom and Megdal (1993)
1977	–6.0	Yes	Yes	Yes	Ashraf (1996)
1982	–14.0	No	No	Yes	Haberfeld and Shenhav (1990)
1984	–6.6	Yes	Yes	Yes	Bellas (1993)
1984	–9.0	No	No	No	Ransom and Megdal (1993)
1984	–7.7	No	Yes	No	Ransom and Megdal (1993)
1984	–9.0	No	No	No	Barbezat (1989b)
1984	–6.8	No	Yes	No	Barbezat (1989b)
1984	—[2]	Yes	Yes	Yes	Ashraf (1996)
1987–1988	—[2]	(new hires)	No	No	Formby et al. (1993)
1988	–8.3	Yes	Yes	No	Broder (1993)
1989	—[2]	Yes	Yes	Yes	Ashraf (1996)
1993	–3.0	No	No	Yes	NSF (1996)[3]

[1]Indicates years covered by data used in study.

[2]Female differential not statistically significant.

[3]Sample includes doctorate earners employed outside of academia.

[4]Model estimated from sample of individuals earning doctorates between 1958 and 1963.

[5]Model estimated from sample of individuals earning doctorates between 1967 and 1971.

ings after accounting for the effects of control variables. For example, the estimated differential in 1965 reported for the Ferber and Kordick (1978) study is –12.1 percent. This means that Ferber and Kordick estimated that, other things being the same, women faculty earned 12.1 percent less than male faculty in that year.

The estimated salary differentials in Table 3-1 show a relatively clear pattern over time. Studies that examined academic salaries in 1975 or earlier, with the exception of 1972 (Ashraf 1996), show double-digit percentage differences between men's and women's salaries. Barbezat (1987) estimated female-earnings differentials in 1968–1969 of 16.5 percent and 21 percent, depending on controls. However, after 1975 only the study by Haberfeld and Shenhav (1990) shows a higher than single-digit percentage differential.

The Equal Pay Act of 1963 and Title VII of the Civil Rights Act of 1964 both provide protection to women against discriminatory employment practices. Faculty at colleges and universities were initially exempt from the legislation, but in 1972 several executive orders and legislative acts made discriminatory treatment of women illegal in the academic labor market (Ransom and Megdal 1993). One explanation for the observed decline in estimated salary differentials is that colleges and universities implemented reforms in the affirmative action era that improved the relative earnings of women faculty by the late 1970s.[18] After 1977, however, female-earnings differentials appear to have flattened out.

Three studies of salary differentials in the 1980s show no significant differences between men and women in earnings. However, the results for two of these years, 1984 and 1989, are based on the Ashraf (1996) study, and Ashraf included academic rank as a control variable in his study. Discrimination in promotions will tend to mask male-female salary differentials. The insignificant result for the years 1987–1988 is based on the Formby et al. (1993) study; however, Formby et al. restricted their sample to new hires and studied salaries for only the academic field of economics.

The Effects of Control Variables on Earnings Differentials

Table 3-1 indicates whether three important kinds of variables—academic rank, publications, and marital status or the number of children—are included as controls in the studies listed. Including rank in faculty salary studies is controversial because discriminatory treatment in promotions tends to mask male-female salary differentials. The issue of scholarly production (e.g., the number of publications) is also important because most of the available evidence suggests that women publish less frequently than men do.[19] As a result, excluding scholarly production as a control is likely to increase measured salary differentials. Finally, we might hypothesize that family responsibilities negatively affect the career advancement, and hence earnings, of women faculty. In short, we would expect that including all three kinds of controls would reduce measured salary differentials.

Finding empirical evidence for these effects from the literature as a whole is complicated by the fact that different studies control for different combinations of factors, and because the gender gap appears to be changing over time. For the pre-1976 period, studies that excluded controls for rank, publications, and family characteristics tended to measure the largest salary gaps. For example, Barbezat (1987) measured the largest gap, 20.7 percent in 1968–1969, when she controlled for none of these factors, but when she controlled for publications, her estimate of the earnings gap for the same time period fell to 16.5 percent. Ashraf (1996), who controlled for all three factors, estimated the smallest pre-1976 earnings gap, 9 percent in 1972. A similar pattern appears in the post-1976 period. When controls for these three factors were excluded, Ransom and Megdal (1993) showed the largest post-1976 salary gaps, 9.9 percent in 1977 and 9.0 percent in 1984. Barbezat (1989b) also measured a 9.0 percent gap when these controls were excluded.[20] In contrast, Ashraf (1996), who controlled for all three factors, found no statistically significant salary gaps in his analyses of post-1977 data.

Some studies have focused on the issue of family responsibilities, but the evidence appears to be mixed. Johnson and Stafford (1974) attempted to address this issue indirectly by measuring returns received from work experience for men and women faculty members. They found that compared to men, women receive lower returns from experience (i.e., women's earnings are affected less by extra years of experience than are men's earnings) during typical child-rearing years. They interpreted this result as being consistent with the notion that be-

[18]See O'Neill and Sicherman (1997), Ransom and Megdal (1993), and Barbezat (1989b) for similar interpretations.

[19]See Section 5 of this review.

[20]Note that when Barbezat controlled for publications, the gender gap fell to 6.8 percent.

cause of job interruptions, women tend to accumulate less human capital than men do.[21] Similarly, Farber (1977) found that percentage increases in earnings for women faculty are lower than those for men only during childbearing years. However, Strober and Quester (1977) criticized Stafford and Johnson's interpretation of results, noting that the data they used do not include workforce interruptions. And Barbezat (1987) found that marital and parental variables do not have the predicted effect on female salaries.

Some of the indirect evidence on the effects of marital and parental variables is also mixed. If family responsibilities cause workforce interruptions, marital and parental variables might explain higher female exit rates from the science and engineering professions. Preston (1994) found that marital and parental variables positively affect female exit rates but not enough to explain the gender differential.[22]

Institutional Samples

Table 3-2 summarizes estimates of earnings differentials derived from studies of single academic institutions. All but two of these studies found negative salary differentials for women. Koch and Chizmar (1976) found that women earned about one percent more than men in 1973 at one institution. Raymond et al. (1988) found no significant difference in salaries earned by men and women faculty at another institution in 1984. Both studies controlled for academic rank.

The studies listed in Table 3-2 are arranged chronologically, but we caution against drawing inferences about trends in the gender gap over time. Variations in conditions across different institutions are likely to be large enough to distort changes that could be occurring over time. Megdal and Ransom (1985) studied data from the same institution at three points in time. They found negative salary differentials for women of 10.5, 6.3, and 9.5 percent in 1972, 1977, and 1982, respectively.

We have also indicated in Table 3-2 whether the various studies controlled for academic rank, publications, or marital and parental variables. Again, however, we caution against drawing conclusions about how these control variables affect estimated earnings differentials, because of likely variations in conditions across institutions.

Table 3-2. **Estimates of gender differences in earnings in single-institution samples**

Year[1]	Female differential (Percent)	Rank included	Publications included	Marital status or children	Source
1969	–15.0	No	Yes	No	Katz (1973)
1970	–9.0 to –11.0	Yes	No	No	Gordon et al. (1974)
1972	–10.5	No	No	No	Megdal and Ransom (1985)
1972	–4.0	Yes	No	No	Koch and Chizmar (1976)
1973	+1.0	Yes	No	No	Koch and Chizmar (1976)
1974	–10.0	No	Yes	No	Ferber et al. (1978)
1974	–16.0	No	No	No	Hoffman (1976)
1975	–2.0	Yes	No	No	Brittingham et al. (1979)
1977	–6.3	No	No	No	Megdal and Ransom (1985)
1977	–2.0	Yes	Yes	No	Martin and Williams (1979)
1980	–3.0 to –5.0	Yes	No	No	Hirsch and Leppel (1982)
1984	—[2]	Yes	Yes	No	Raymond et al. (1988)
1982	–9.5	No	No	No	Megdal and Ransom (1985)
1985	–5.0	Yes	Yes	No	Lindley et al. (1992)
1987	–6.0	Yes	No	No	Becker and Goodman (1991)

[1]Indicates years covered by data used in study.

[2]Female differential not statistically significant.

[21]Johnson and Stafford also found that the salary gap tends to narrow after age 45, when women reenter the workforce and begin accumulating more human capital.

[22]Preston's sample is not limited to scientists and engineers employed in academia.